"MEASUREMENT OF HIGH VOLTAGES" IN THIS NUMBER

THE ELECTRICAL EXPERIMENTER

SEPT. 1914

PRICE 5¢

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"The Experimenter's Magazine"

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H. GERNSBACK, Editor — H. WINFIELD SECOR, Associate Editor

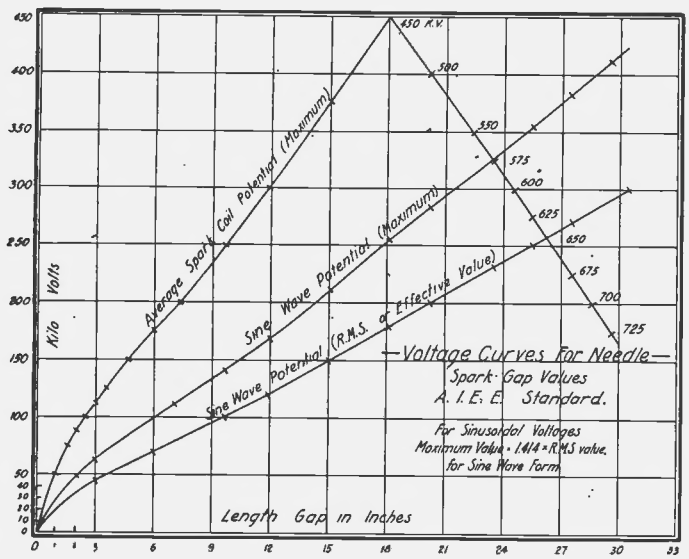
THE ELECTRICAL EXPERIMENTER

VOL. II — SEPTEMBER, 1914 — NUMBER 5

The Measurement of High Voltages

By H. Winfield Secor, A. M., I. R. E.

HIGH voltages are measured in several ways. In practice, among the methods in vogue, being that using a static voltmeter, and the calibrated air gap. We present herewith a set of curves which may be used with a needle point spark gap, for measuring the voltage of a current sufficient to jump an appreciable air gap. Sharp steel sewing needles are used for the electrodes and new



needles are generally used for each new reading. There are two values to a spark potential known respectively as the "root mean square voltage" and the "maximum voltage." For true sine wave alternating currents, as produced by an A. C. Dynamo, the R.M.S. voltage (which is the one always indicated on common A. C. voltmeters), multiplied by 1.414, gives the maximum voltage for this particular wave form. Hence a 110 volt A. C. line has 1.414 times this value as a maximum potential, and this latter voltage is the one that tends to break down insulation, etc., so that in measuring high potentials by the spark gap method, the maximum voltages are easily obtained for electrical engineering purposes, in aiding to design apparatus, etc., and the General Electric Co. build an apparatus for the measurement of high voltages based upon this principle. It uses a needle spark gap, and a calibration curve, similar to those here presented accompanies each instrument. The amateur, by means of these curves, can easily ascertain the spark potential of his spark coil or transformer. If the transformer is operating on a commercial A. C. circuit, then the wave form of the voltage will be quite close to a sine wave, and the maximum potential will be about 1.41 times the R.M.S. volts. If it is a spark from a spark coil, such as the 1" or 2" "Bull-dog" type, etc., then the potential wave form is quite peaked and descends sharply and rapidly to a zero value; for this sort of wave form, the "amplitude factor" as it is termed, becomes something like 2.5 and hence such a 1" spark between needle points will have an "insulation smashing" or maximum potential value of 20,000×2.5 or 50,000 volts. So that the amateur is fully correct if he posts up a sign reading "50,000 Volts, Danger," if he has but a 1" spark coil. From this it is seen that one may speak of a spark potential in two ways, i. e., he may mean the R.M.S. or practically the equivalent D. C. value; or again the maximum value, and of course this should be rightly understood before one really knows which a person means. Usually the R.M.S. value is meant when a spark voltage is stated. The R.M.S. curves here given have been plotted from the standard spark values as adopted by the American Institute of Electrical Engineers and those interested would do well to send 10 cents to the Secretary of the above Institute, at 39 West 39th Street, N. Y. City, for a copy of their "Standardization Rules," covering this subject in detail.

A NOVEL ELECTRO-THERAPEUTICAL AND HIGH FREQUENCY APPARATA.

PORTABLE and high frequency X-Ray apparata are in great demand nowadays, for the requirements of surgeons, physicians, diagnosticians, etc., and one of the neatest as well as effectual apparatus of this character is supplied by the E. I. Co. as illustrated in our cut Fig. 1. This extremely neat and compact machine measures about 6"x11"x7" and works universally on 110 volt 60 cycle A. C. or D. C. and can be readily plugged into the nearest lamp socket. This machine represents one of the latest type, specially designed high frequency outfits, and the high voltage high frequency current produced, can also be used for exciting an X-Ray tube as well as for the purpose of electro-therapeutical treatment by auto-condensation, etc. An improved form of ozone generator illustrated at Fig. 2 is also

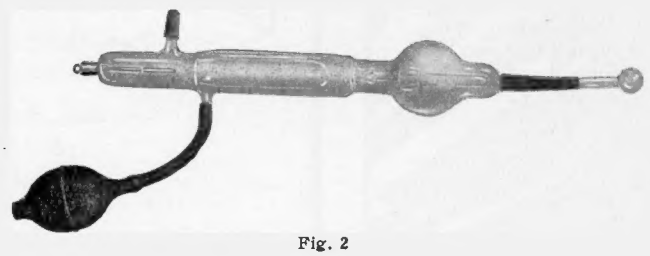


Fig. 2

supplied for use with this machine at a cost of $10.00 additional, and this device is very efficacious for ventilating purposes or treatment, etc., where Ozone is to be used.

This Ozone generator is made of glass and the action of same is as follows: The terminal below (nearest) the rubber bulb is connected to the high frequency machine illustrated at Fig. 1, and one hand is closed around the glass above the bulb, while the other hand operates the rubber compression bulb. Air is forced thru the small space between two tubes, thru which a silent electrical discharge takes place, and it is

(Continued on Page 67)

"The Electrical Experimenter" is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is 50 cents a year in U. S. and possessions, as well as Canada. Foreign countries 75 cents a year. U. S. coin as well as U. S. Stamps accepted (no foreign coin or stamps). Single copies 5 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of the Electro Importing Co.
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All communications and contributions to this journal must be addressed to: Editor, "The Electrical Experimenter," 233 Fulton Street, New York. We cannot return unaccepted contributions unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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HOW TO USE THE "ELECTRO" LOOSE COUPLER.

A loose coupler is nothing else but an alternating or oscillating current transformer, and depends for its action upon the fact that an alternating or pulsating current passing thru the primary coil will by electromagnetic induction set up or induce corresponding currents of similar frequency in the second or secondary coil. The outer coil of the loose coupler is the primary, and is connected to the aerial and ground wires as shown in the diagram given herewith. The connections to the primary may differ from those given here, but these are the common ones.

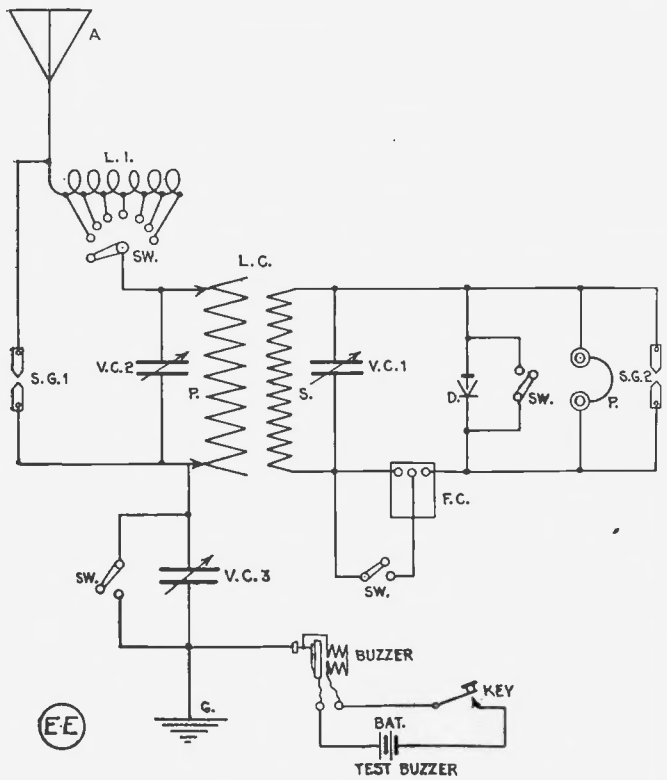


FIG. 1

Looking at the diagram, it is seen that the secondary connections are quite simple. The connections depicted here have been thoroughly tried out, and are widely employed by commercial and amateur stations, to give the greatest flexibility to the tuning of the apparatus to different wave-lengths.

For receiving medium wave-lengths, in the neighborhood of 600-1000 meters, the ordinary aerial will have sufficient inductance and capacity together with that of the coupler primary winding, to enable the operator to tune to these wave-lengths, by simply moving the primary sliders until the signals are heard the loudest. To receive wave-lengths of a lower value than the natural period of the antenna and primary winding, it is necessary to connect a variable condenser or capacity in series with the aerial or ground wire.

For receiving ordinary wave-lengths with the loose coupler having an adjustable secondary inductance, it is also necessary for best results to employ a variable condenser connected across the secondary winding, as shown in the diagram. The variable condenser here mentioned may be any of the E. I. Co. types of variable receiving condensers.

When tuning to wave-lengths of say more than 1,200 to 1,500 meters, the circuits of the coupler must be adapted so that sufficient capacity and inductance can be placed in circuit, to balance or synchronize for such wave-lengths. One method of accomplishing this compensation for long wave-lengths in the primary circuit, is to connect a variometer or loading-coil (single slide tuning coil), in series with the aerial lead-in wire. Also a variable capacity may be connected across the coupler primary coil as shown, and this connection helps to increase the product of the $\sqrt{LxC}$, which is known as the oscillation constant of the circuit, L being the inductance and C the capacity.

When arranging the circuit for tuning in long wave-lengths it is of course imperative to add more inductance or capacity to the secondary circuit of the coupler. The usual way is to connect a variable condenser across the secondary terminals, thus making it possible to tune this secondary circuit with the primary circuit. The oscillating or tuning circuit for the secondary is around thru its winding and variable condenser. Hence the wave-length period of this closed circuit is easily found by the usual formula:

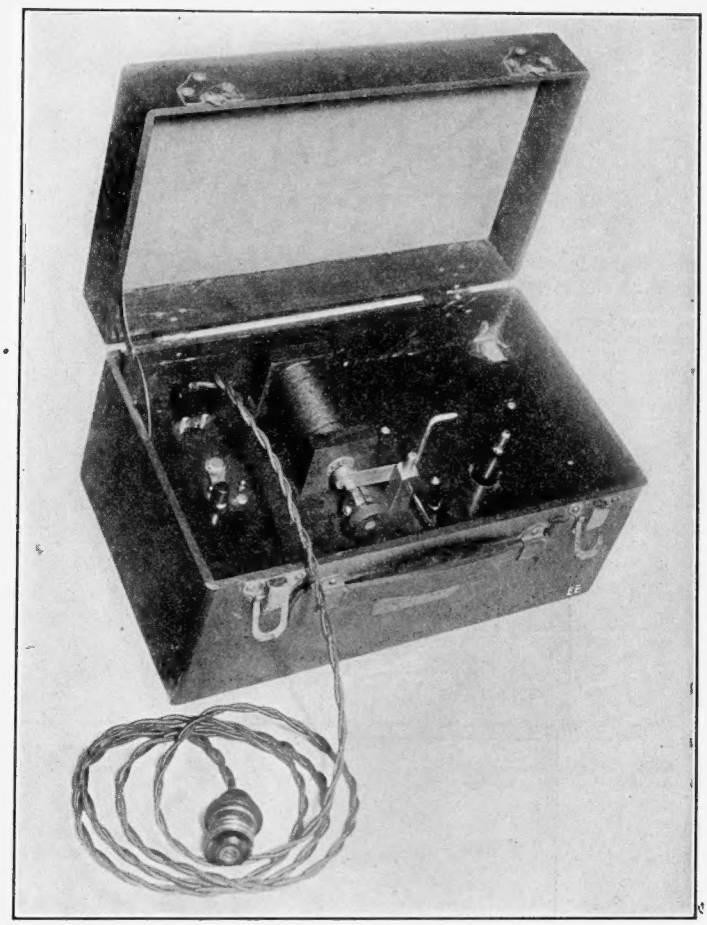
$$\text{W. L. in meters} = 59\ \sqrt{L\ C};$$

where L is the inductance of the secondary coil and connecting leads in *centimeters*, and C is the capacity of the variable condenser connected across it in *micro-farads*.

The inductance in centimeters of the secondary coil of the No. 12002, E. I. Co. loose coupler, is about 516,000 cm. Hence, if their type 3500 variable condenser is connected on multiple with this inductance (the maximum capacity of No. 3500 condenser being .01 M. F.), the natural period or wave-length of the secondary circuit would be about 4,285 meters. If one of their smaller capacity condensers such as No. 9241 of the slide plate type, which has a capacity of .0016 M. F. is utilized across the secondary, then the wave-length capacity would be approximately 1,712 meters. With the condenser No. 9240 in circuit the wave-length capacity would be but 1,355 meters, as this condenser has a maximum capacity of .001 M. F. Some systems also make use of a series tuning inductance in the secondary circuit, connected in series with the variable condenser and loose coupler secondary winding.

A NOVEL ELECTRO-THERAPEUTICAL AND HIGH FREQUENCY APPARATA (Continued.)

converted into Ozone in the usual well known manner, in consequence. The glass bulb is partly filled with oil which washes the ozone; the purified ozone is then forced out at the top of the instrument. This makes the device particularly efficacious for the requirements of physicians and others giving this form of treatment to patients, etc.



This high frequency machine complete with 6 glass vacuum electrodes together with Universal handle fitting same, and which fit in the lid of the carrying case, is worth $35.00 with attachment cord and plug for connection with the nearest electric light socket, and also including treatment, cables and cords. Fulgeration Electrode is worth $2.50 extra. Auto Pad, for electrical saturation, $3 extra. Hair Electrode, $4 extra. Fluoroscope, $12.00 extra. X-Ray Tube and Holder, $18.00 extra.

This machine has been on the market for over five years and is one of the most successful of its type now widely used by physicians and those interested in this class of electrical apparata.

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Experimental Electricity Course

By S. Gernsback and H. Winfield Secor

LESSON 13.

THE X-RAY (Concluded).

In practice, however, the concentration is never accurate in ordinary tubes, a compromise being made between the sharpness of focus, and the heating effect. From this it is evident, that anything which enables the anode to lose its heat rapidly, or to stand a high temperature without being damaged, also allows of a more accurate concentration of

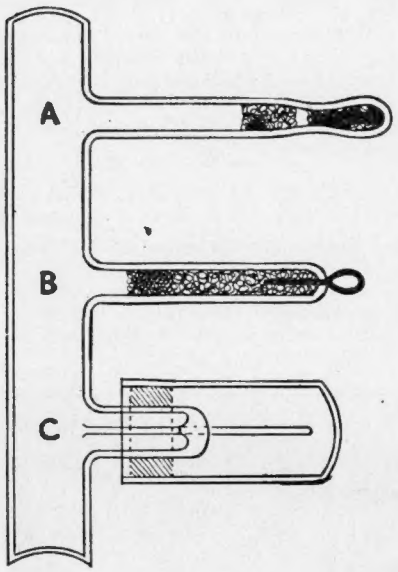

Fig. 9

the cathode stream, and a greater sharpness in the effects produced. Also, such non-damageable anodes permit of a

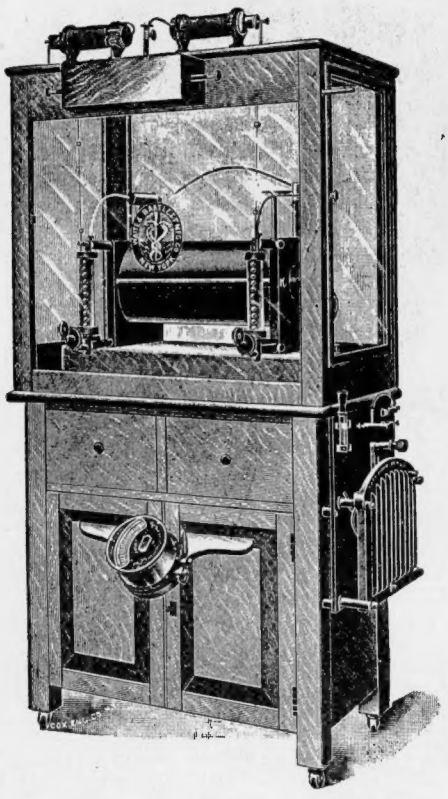

Fig. 10

heavier discharge thru the tube and therefore of greater energy of radiation.

The anode or anti-cathode as it is sometimes called, consists usually of a small plate of metal fixed opposite to the centre of the cathode, and mounted at an angle of about 45 degrees with the axis of the tube.

The X-Rays which are produced radially from it, are thus directed outwards through the side of the bulb, where no electrodes, thickened glass, or other obstructions are met with.

The material employed for the construction of the anode electrode makes a considerable difference in the efficiency of the tube, as found by Roentgen. He states that there is a difference in degree of X-Ray emission, by anodes of different materials, and that at the point of impact of the cathode stream, platinum radiates much more powerfully than aluminum; platinum having a very high melting point (3,000 degrees Fahrenheit), is usually chosen for the material out of which to make the anode electrode.

Excellent results have been obtained with iridium used as a small centre in a disc of platinum.

X-Ray bulbs tend to raise their vacuum after continued use, and change from a soft low vacuum, to a hard high vacuum. There are various methods in vogue for regulating the vacuum of tubes automatically and otherwise. Three principal schemes employed are depicted by the cut fig. 9, at A, is represented the chemical regulator, which requires the application of external heat to them, to become operative. The sealed glass chamber shown, contains potassium chlorate or manganese dioxide, which liberates oxygen gas when heated by the application of a spirit lamp to the outer surface of the glass tube.

The construction shown at B is like the one just described with the exception that a platinum wire is sealed into the portion of the tube containing the chemical. Sparks from the exciting apparatus are allowed to pass into the tube thru the platinum wire, and gas is formed and liberated. The tube can thus be regenerated at will.

The vacuum regulator illustrated at C, is known as the "Osmotic type." It is comprised of a very small tube of metallic Palladium sealed into the side of the X-Ray bulb. The inner end of the metal tube is open and the outer end closed. The tube is covered ordinarily by a glass cap. If this cap is removed, and the flame of a spirit-lamp applied to the closed outer end of the Palladium tube, hydrogen Ions from the interior of the flame will be drawn thru the intermolecular spaces of the heated metal, into the exhausted X-Ray bulb. This form of regulator has the advantage over the proceeding two types, in that the vacuum of the X-Ray bulb, can be adjusted any number of times, but the first two are limited by the amount of chemical in the end of the regulator tube, which is sealed off air tight.

X-Rays present a very entrancing field for unlimited experiment and study, but caution should be observed in subjecting the skin to long exposures of the rays, as they have a property of producing serious sores or growths, which if not checked quickly are incurable. Grave effects are caused on the trophic nerves, and vital resistance of the superficial tissues of the body, followed in a week or more by severe inflammation and necrosis.

A large X-Ray generator with regulating rheostat, ammeter, etc., are shown in fig. 10.

LESSON 14.

HIGH FREQUENCY CURRENTS.

HIGH frequency currents represent the most advanced field of electrical experimentation, and but very few of the wonders of these currents, especially when produced at high potential are known. Hence, a wide scope is given to the investigator and experimenter, in the evolving of new laws and phenomena, from researches in this most interesting and growing branch of the electrical art.

The production of high frequency currents for experimental research, is usually accomplished by the aid of a Tesla coil, which takes its name from Nikola Tesla, a famous authority and investigator on this subject. Two of the principal scientists who have given us data and explanations of these currents are Tesla and Elihu Thompson, who independently and simultaneously obtained practically similar results.

Before delving into the more intricate details concerning the arrangement and operation of Tesla coils, Oudin coils, etc., a few paragraphs will be devoted to the elucidation of the meaning and scope of high frequency as applied to the

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currents in question. It may be stated firstly, that high frequency currents are invariably oscillatory in Nature, or alternating from positive to negative, and back again, many hundred times per second. In the diagram, fig. 1A, is given a graphical representation of the "wave form" and time value, of an ordinary alternating current, such as used for commercial lighting, running motors, power transmission, etc. This current is known as a standard 60 cycle current; one cycle meaning the time consumed for the current to rise from zero to maximum positive value, back to zero, then to negative maximum to zero again. The time consumed by the current rising from zero to positive maximum then to zero, is referred to as an alternation; two alternations comprising a cycle. Hence, a 60 cycle current is one having also 120 alternations, and the time for this series of changes to take place is one sixtieth of a second. Also 60 cycles will take place in 1 minute. One alternation or ½ cycle requires for its transpiration 1/120 of a second.

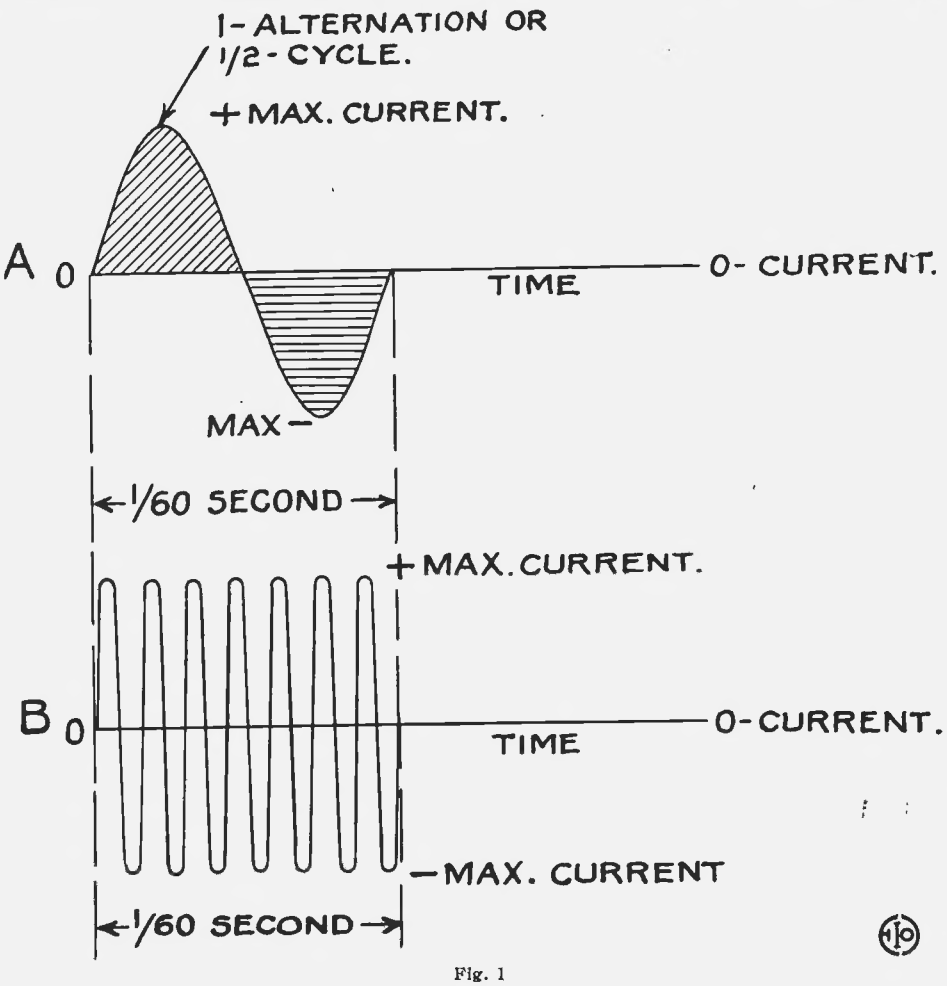

Fig. 1

In the curve of fig. 1 B, is depicted a higher frequency current than the 60 cycle just discussed, or as seen in the same time interval, viz., 1/60 second, seven times as many complete cycles have occurred, or the frequency per second is 7 times 60 or 420 cycles per second. Likewise, this frequency is equivalent to 840 alternations per second, or also 25,200 cycles per minute. Commercial lighting currents usually have a frequency of 3,600 cycles or 7,200 alternations per minute.

This explanation is for the purpose of making clear the exact meaning of the term high frequency. In actual practice, the term high frequency is invariably understood to mean a current whose frequency is somewhere between 10,000 and 1,000,000 cycles per second.

When such frequencies as these are employed, many wonderful and hitherto unlooked for phenomena appear. Among other features which they possess, are those permitting of passing it thru or rather over the human body, at a potential of half a million volts, or more. Tesla, Thompson and others have often demonstrated the feat of passing a million volts thru the body from hand to hand without experiencing the slightest harm or ill feeling. Ordinarily as in the electrocution of criminals, where low frequency alternating current of 60 to 120 cycles is employed, such potentials as 2,000 volts are sufficient to kill the subject. Generally but ¼ to ½ ampere passed thru the heart is sufficient to cause death. With high frequency currents, however, the current strength as indicated by a hot-wire ammeter may easily reach several amperes.

Currents of such frequencies as these, no longer obey the laws governing those of low frequency. For one thing, they travel principally over the surface of conductors, not thru them; penetrating but a few thousandths of an inch, this depending upon the frequency value. The higher the frequency, the less the penetration. From this it is evident that solid conductors for high frequency currents are a waste of material and thin walled or hollow ones of large diameter, are the best. Stranded conductors are always better than solid ones of similar capacity, as the former has much greater surface area for a given cross-section, and this is what counts in this case.

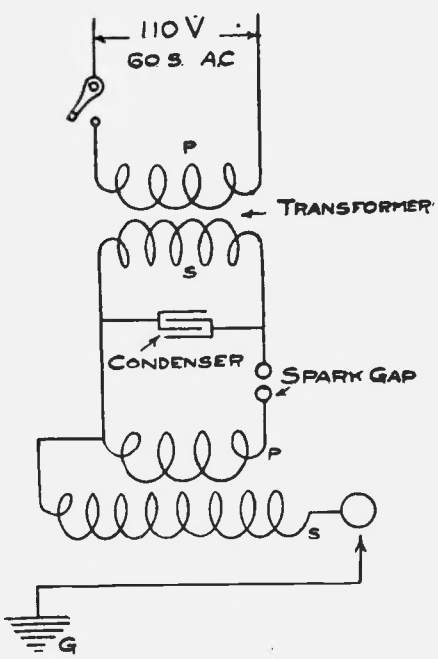

Fig. 3

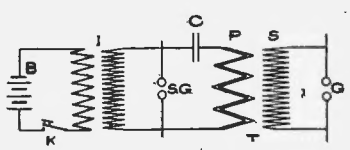

Fig. 2

High frequency currents can be produced in several ways, the principal methods being those involving the use of an Elihu Thompson generator, a Fessenden high frequency dynamo, or by means of the Tesla disruptive discharge set.

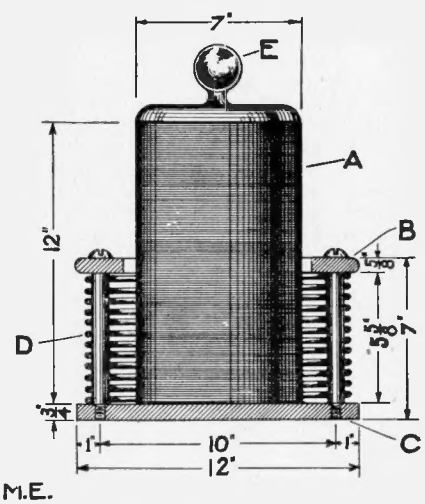

Fig. 3. An Oudin Coil

(To be Continued)

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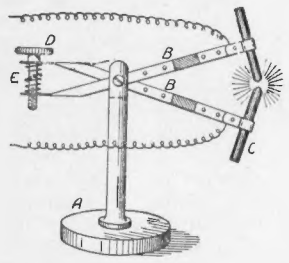
A SMALL HAND-FEED ARC LAMP.

From my own experience I find a hand-feed arc lamp of the "scissors" pattern, a diagram of which I enclose, quite useful for experimental work, says David A. Harrold, in *Junior Mechanics*. A is a metal stand with a vertical slot at the upper end to receive two hinged metal arms B. These are bent to shape at the two rear ends and drilled for the adjustment screw D. This is tapped into the lower arm, the upper one being bored ⅛ in. larger to allow of free movement of the screw. The spiral spring keeps them apart until fed together. The front ends are riveted to fibre strips (shown shaded in illustration) to insulate them from the stand and turned into a loop at the ends to form clamps for the carbons C. To start the arc, adjust by the screw until the correct distance is found.

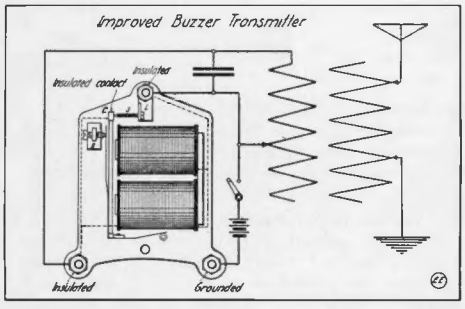


I made a small one of the above type about a year ago, working on 12 volts 2 amps., and the results were as good as could be expected.

ANOTHER IMPROVED BUZZER TRANSMITTER.

When it became necessary to use an oscillation transformer with my buzzer in sending on account of the wireless law, I found that I could not bridge the distance that I had previously. Not wishing to use my large set for local work, I changed the windings on the magnets of the buzzer, put on another contact or gap and now I can cover a longer distance with an oscillation transformer than I could without it.

I removed the two magnets from the buzzer and also the windings from them. The iron cores were covered with empire tape, and one of the magnets wound with No. 20 insulated wire and the other with No. 36. The former is placed nearer the free end of the armature as the speed of vibration can be better regulated. The inside ends of the wire on the two magnets are then connected together and to a binding post set in the upper screw hole and insulated from the frame. The screw is also used to hold a small lug "L" which is threaded for the screw "S."



The other end of the No. 20 wire is attached to the adjusting screw bracket "B" as in the regular buzzer connections. The other end of the No. 36 wire is fastened to the insulated binding post of the buzzer and to the insulated contact on the armature. "C" is so placed that it forms a small gap with "S," the length being regulated by "S."

This arrangement makes the buzzer like a small closed core transformer, but since such an instrument will not work on battery current, the vibrator must be used. A small condenser, around the "primary" contact to reduce the sparking, will increase the efficiency of the buzzer. If the buzzer is used in connection with a step-down transformer instead of batteries, the "primary" contact may be done away with and the ends of the No. 20 wire connected, with a key in series, direct to the low voltage side of the transformer.

The gap is synchronous and the set would emit only one wave length. The buzzer used was one obtained from the E. I. Co.

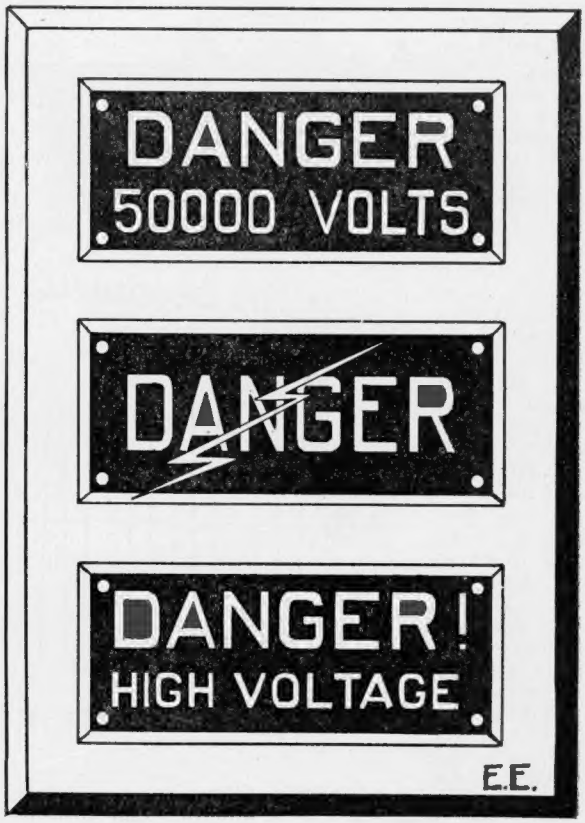
Contributed by

FRANK H. BROOME.

The boy scouts of Fort Worth, Tex., have a wireless station completed on the association building. The station will be one of the best amateur stations in the south. Karl Broadlay will be the chief operator.

DANGER SIGNS FOR RADIO STATIONS.

A few designs are given herewith for Danger Signs suitable to be posted in a conspicuous place in radio stations, where high voltage transmitting equipment is used and the amateur radio man will do well to post one of these signs in his transmitting station, so that the uninitiated will keep their hands off high voltage wires. These signs can be very



easily laid out on a piece of Bristol-board or drawing paper, and red letters on a white background probably make one of the best and most conspicuous signs. Also the designs we show of white letters on a black background are very good, or black letters may be used on a white background, as desired.

The signs should be made up in the particular designs desired by the reader, to have a size of about 6 to 8 wide, by 12 to 15 inches long, or they can be made smaller if preferred.

PASSES EXAMINATION AS WIRELESS EXPERT.

Norman G. Snyder, son of Professor and Mrs. Virgil D. Snyder, of University Avenue, has been awarded 100 per cent. in examinations by a government inspector for the position of first grade wireless operator.

Snyder has accomplished a number of wonderful feats for one so young. He has accomplished much along the line of simultaneous receiving and intends later to delve into the mysteries of wireless telephony.

ST. JOSEPH'S HOLY NAME MILITIA RADIO.

A wireless station was equipped by the St. Joseph's Holy Name Militia of St. Joseph's Church, Traphagen Street and Central Avenue, West Hoboken, in their camp at Atlantic Highlands and kept the boys interested much of their time.

The wireless outfit was erected by and in charge of A. Beigen, who, although only 17 years old, has a government license to operate.

From his aerial apparatus, strung on a 50-foot pole near his house, Calvin Clemmer, a railroad telegraph operator at Pennsburg, Pa., sits in his attic laboratory almost nightly and catches the wireless messages about the European war and other important events.

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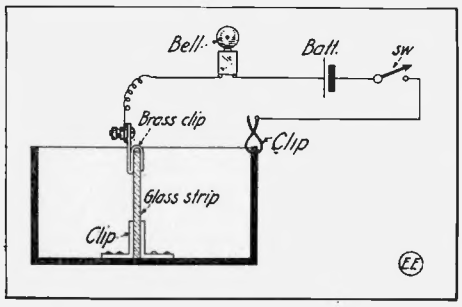
A DRIP PAN ALARM.

Many times somebody has forgotten to empty the drip pan underneath the refrigerator. Now is the time to show mother that your electrical experiments are really useful by making her a "drip pan alarm." Taking for granted that the pan is made of metal, the first thing to do is to make a bracket to support the glass strip or rod as shown in figure 1. The bracket is made of springy brass and riveted to the bottom of the pan or to a slate base, etc. The glass strip is then inserted in the bracket. Mount a small bolt and clamp on the edge of the glass at the height which it becomes necessary to empty the pan when the water rises that far. Clip one of the E. I. Co.'s helix clips on the edge of the pan. Lead an insulated wire from the bolt on the glass to one of the binding posts of the bell. If there is any slack wire let it hang over the edge of the pan. The diagram of connections is as shown.



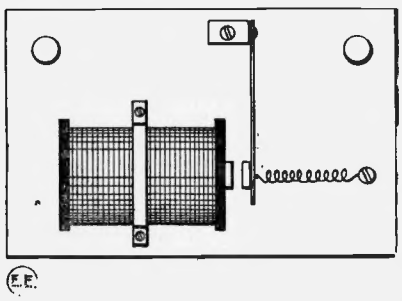
When the pan is full the bell will ring until some one comes. The E. I. Co.'s Lilliput Bell should be used as it is small yet has a loud sound and can be easily screwed in a corner. To pull the pan out slip out glass strip and unhook clip.

Contributed by

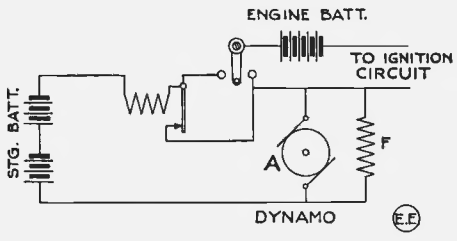
NATHAN WOLPERT.

A SIMPLE AUTOMATIC CUTOUT.

Those using a small dynamo charging storage cells for house lighting, wireless or similar uses, will appreciate this description of how to make a simple cutout to prevent batteries from discharging back into the dynamo; if the engine should stop or for any reason the charging current drops too low.



The drawing shows its construction well enough so that a lengthy explanation is unnecessary. An E. I. Co. No. 01107 electro-magnet and some odds and ends, are all the apparatus necessary. The armature is mounted on a piece of 1/16 brass ⅜-inch wide, supported at one end, by a small block of wood ½-inch square and ¼-inch high. A small spring is attached to the armature to draw it away when current fails; although this may be done away with if the armature support is made of spring brass or steel spring.



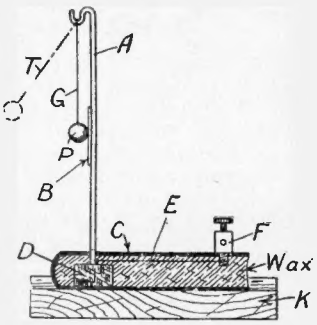
As the magnet resistance is too high for very small plants, it may be rewound with larger wire. This will bring the resistance down low enough. This may be connected in series, as is the usual practice, or as shown in hook-up. Here the engine ignition circuit is opened when cutout operates, so when the batteries are fully charged it will stop the engine. In starting up, switch is placed on contact No. 1 till batteries are cut in; then throw to point No. 2 quickly.

Contributed by

THOS. W. BENSON.

A SIMPLE ELECTROSCOPE.

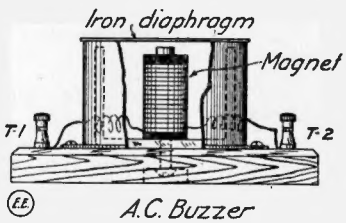
Our sketch shows the electroscope complete where A is a piece of thick wire, B a metal disc soldered to it, C is a piece of fountain pen barrel filled with wax, D is a block of hard rubber to keep the wire firmly fixed, E is a wire joining A to the terminal F. The whole is stuck to a wooden base K. A pith ball P hangs from the hook by a piece of silk G. On connecting the terminal to one of the collecting knobs of the Wimshurst machine (such as the "Electro" No. 9000 Static Machine), the pith ball is repelled, standing out as at T, says *Junior Mechanics*. On touching the wire with the finger the ball drops to its original position again.



It is does not work properly try standing it on a piece of glass to insulate it from the ground.

LOW VOLTAGE A. C. BUZZERS.

Low voltage A. C. is used more and more every day for ringing bells and buzzers of the ordinary vibrating battery type, but a simple form of A. C. buzzer is easily made from a No. 1024 watch case receiver shell, less the permanent magnet, and winding the bobbin or magnet in same with No. 22 insulated magnet wire. Also a 20 ohm E. I. Co. electro-magnet No. 01107 can be used. An iron diaphragm as shown is caused to rapidly vibrate by the A. C. from a bell-ringing transformer, and thus gives out a musical hum.



The distance between the magnet pole and the diaphragm has to be very critically adjusted, or no appreciable sound will be produced. A tin can and its bottom or top may be used as per our sketch, the can being of the ordinary *baking powder* variety, with a diameter of about 2 inches. If the diaphragm cannot be made adjustable the magnet can be made so, by mounting it on a machine screw, as shown; 8 to 12 volts A. C. as given by bell ringing or Toy type A. C. step-down transformers, operates this buzzer nicely.

TUCKERTON RADIO IS CLOSED.

The management of the Tuckerton wireless station was notified Aug. 24 that the call letters temporarily assigned had been cancelled. Further operations will subject the station to penalties, including forfeiture of the apparatus. In effect, it has been ordered closed.

The action was taken because the Tuckerton station never has been licensed, as is required in the radio laws. It began operating last May in the experimental stage, and lately has been the only direct means of communication between the United States and Germany. Other stations operating are said to require a relay during the summer. The Tuckerton tower is said to be the only one having a system capable of overcoming sratic conditions in hot weather.

The wireless station at Sayville, L. I., is licensed and now under censorship and is receiving direct the latest war news from the Nauen station in Germany.

INLAND NAVAL WIRELESS PLANT.

Work on the new naval wireless telegraph station at Lake Bluff, Ill., will be started immediately.

The radio station will communicate, among other points, with Panama, San Francisco, Key West, New York and Seattle. Six operators will be detailed to the station.

By means of a wireless telephone apparatus invented by two French Naval Officers, Commander Victor Colin and Lieut. Maurice Jeance, conversations were carried on the other day over a distance of 150 miles. The words came with greater distinctness, it is said, than is customary, even over a telephone connected by wire, the speaker's voice being clearly recognizable. But will anybody believe that a French conversation was carried on out of eye-sight?

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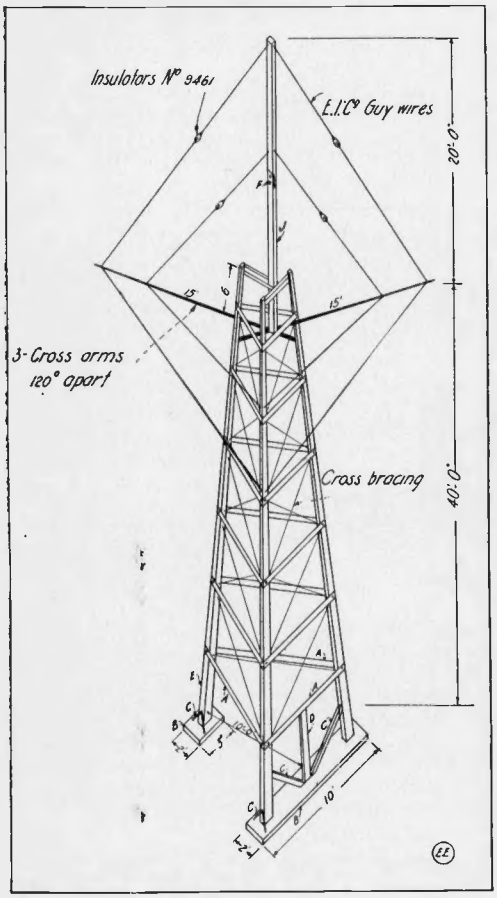
WIRELESS DEPARTMENT

AERIAL MAST CONSTRUCTION.

I give herewith description of a wireless tower which I built last summer, and being successful with it, I have decided to give the plans to the readers of *The Electrical Experimenter*. The reason I preferred this design was that I could increase the length of my aerial without having to anchor my guy wires on neighbor's premises and a longer aerial means greater range. The whole affair was built on the ground, and raised by a few men with the aid of a team of horses and block and tackle. The first two sections are composed of 6 ordinary scantling, as legs, while the last two, which includes the pole, is of lighter material. Figure 1 gives a fair idea of the construction of the foundation. The planks B, B, are an inch thick; c, c, and D supports it on the front part while four are used on the back leg. The foundation I used was four feet deep in hard clay soil. It is well to soak the foundation parts well with tar or oil as this will preserve them for a much longer time. The cross bracing is fence wire twisted together till tight. This is much cheaper and offers less wind resistance than boards. The boards A. A. Fig. 1, are ½ inch thick and 3 inches wide and are secured by means of screws of suitable size. All the main joints such as at F. are secured by three iron bolts and nuts.



Referring to figure, we can readily see how the cross arms which secure the guy wire are fastened. They are bolted to G, and further secured by iron clasps H. The front cross arm M is fixed in position after the tower has been raised 16 feet. The pole J, has at least six feet to be fastened to the main part. The main part is two-thirds of the entire height, or 40 feet; while J is one-third or 20 feet; so in case the builder wishes to make his mast higher, he may keep this in mind. The guy wires which are E. I. Co.'s stranded form, are divided in half by insulators No. 9461, six of which are required. The cross arms must be 120° apart so to insure good bracing. Before raising, attach your pulley to the top and see that all the joints fit snug. Also try the tightness of the guy wires and brace wires. Before raising I tested its rigidity, by letting two-thirds be supported one-third of the way up. Later a 60-mile gale that swept the Great Lakes gave it a good test, which the aerial was slightly the worse for, as were many others in this part. The sketch gives you an idea of the whole affair.

Contributed by

CHARLES FITZGERALD.

The wireless is now justly regarded as the greatest of modern inventions in that it can tell us many things that aren't so.

THE SAYVILLE WIRELESS STATION.

The new wireless station erected by the Atlantic Communication Co., at Sayville, L. I., is probably one of the most unique wireless stations and one of the latest type thus far built, in view of the fact that a considerably high voltage is employed in connection with quenched spark gaps. This station has a triangular latticed steel mast, 150 meters high, resting on a large glass insulator at the foot of the mast; and of course a great number of steel guy rods serve to hold the mast in its upright position. The aerial employed is of the umbrella type, and the lead-in wires are connected at the upper ends of the aerial strands composing the umbrella. The power units employed at Sayville at present compose a small transmitting set having a 15 H. P. motor connected to a 500 cycle alternator of corresponding size and a large transmitting set employing a General Electric 75 H. P. motor direct connected to a 500 cycle alternator of about 50 kilowatts capacity. The small transmitting set is used for all short distance work such as a communication between shore and ship stations over fairly long distances, and this small set has worked as far as Colon, Panama, at night. The large transmitting set when in full activity delivers 45 to 50 kilowatts, 500 cycle alternating current, to a step-up transformer, which delivers a secondary potential of 60,000 volts.

A battery of quenched spark gaps of special design are utilized in connection with the 60,000 volt transformer, and these gaps have their spark plates spaced .15 to .2 mm. apart, approximately 1,000 volts per gap is allowed and thus about 60 gaps are generally employed. A large motor driven blower is placed back of the gaps and forces a strong draft of air around and between them, thus serving to cool them as well as possible.

Both small and large transmitting sets are controlled by the operator, who handles an ordinary Morse telegraph key, and this in turn controls a circuit in which are connected very heavy specially designed relays; which are very quick acting and have multiple contact points, and these contact points are cooled by means of a fan blowing a draft of air over them. The small transmitting set is controlled by a relay in the primary circuit, also, and this part of the installation works perfectly at high speed transmission, even when an automatic tape sender is employed, using about 50 K. W. A. C. in-put into the transformer of the large sending set; and 120 amperes, aerial current, is radiated; the radiation resistance being approximately 3 ohms.

In receiving messages, even from a long distance, the operator does not wear any wireless receivers of the conventional style on his head, the incoming signals being amplified to such an extent that the sounds are heard distinctly in the operating room, and resemble the striking of a piano string. The efficiency of the transmitting set as regards transformer in-put, to the energy radiated in the aerial, often reaches 75 to 80 per cent.; which is probably more than that of any other system at the present time, thus showing the exceptional value of the quenched spark gap, when properly employed. Some very long distance work has been done by this station, and it has communicated to Nauen, Germany, at several different periods.

This station probably represents the latest advance at this time in efficient radio telegraph stations, and also it represents a very smooth working plant, as practically no noise is given out when sending, due to the quenched gaps.

(*Excerpt from lecture delivered before the Institute of Radio Engineers, April 2nd at Columbia University, by the chief engineer of the Atlantic Communication Co.*)

CONDITIONS FOR TESTING WIRELESS STATIONS.

The attention of owners and operators of radiotelegraph stations is called to the fact that considerable interference is being caused near the larger centers of population by stations conducting tests without due regard to the traffic being simultaneously carried on. Commissioner E. T. Chamberlain of the Bureau of Navigation, United States Department of Commerce, gives notice that stations desiring to conduct such tests should communicate with the local radio inspector by letter or telephone, stating the probable length of time that will be required. A station conducting tests or temporary experiments should "listen in" to determine that no interference is being caused, and during the test should "listen in" frequently for the interference signal, "Q R M." The station conducting tests must also transmit its official call signal frequently. These radio tests have been heard repeatedly at the E. I. Co., Radio Laboratory, New York City, sometimes for periods of one and two hours. Considerable interference has been noticed frequently due to these tests.

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HOW-TO-MAKE-IT DEPARTMENT

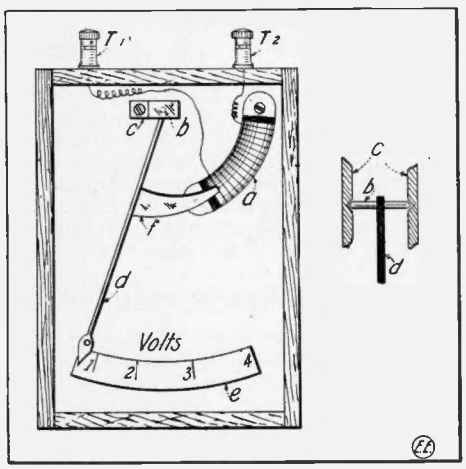
This Department will award the following monthly prizes: FIRST PRIZE $5.00; SECOND PRIZE $2.00; THIRD PRIZE $1.00. The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical, and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted, a prize of $5.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE, $5.00.

MAKING SIMPLE VOLTMETERS AND AMMETERS.

By Frank K. Murphy.

A voltmeter can easily be constructed from odds and ends with but little trouble. The solenoidal or magnetic suction type will be found suitable, but great care must be taken to make the moving part as light as possible. The bobbin *a* is built up of cardboard well glued together, and is of rectangular section about ½" by ⅛". It is wound with 1 oz. of No. 36 single cotton-covered wire, and then soaked in paraffin wax. The pivot *b* is made from an old watch or clock balance wheel setting, or on that principle as detailed in sketch at *c*. The spindle carries a light brass or aluminum wire *d*, which holds the scythe shaped iron armature *f*, and also forms the pointer which moves over the cardboard scale *e*. Cut the armature from the thinnest iron procurable (a condensed milk tin is about right, but if too heavy can be thinned down in dilute nitric acid). It must be cut accurately and filed to swing easily in the bobbin, which it must not touch anywhere. The calibration is done easily by means of dry cells, which give 1.5 volts each; 2 gives 3 volts; 3 give 4½ volts, etc.

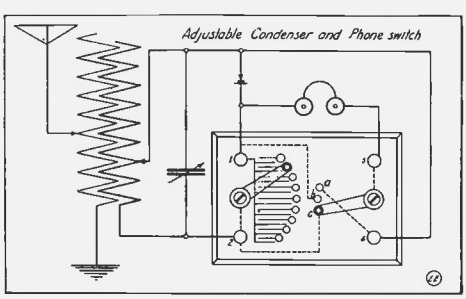


The amperemeter is made in a similar manner, but the wire used on the bobbin is No. 18 double cotton-covered. A light wooden brass case should be put round the instrument and a card *e* can be arranged on which to mark the volts and amperes. When calibrating, the voltmeter is wired in parallel with a standard instrument and the amperemeter in *series*.

SECOND PRIZE, $2.00

"ADJUSTABLE CONDENSER AND 'PHONE SWITCH."

By experiment it will be found that some stations can be read better when the phones are connected in parallel to the fixed condenser and in series with the detector or vice versa. As numerous scattering switches take up much room and are usually inefficient and confusing, it is well to keep each switch with its own instrument. A switch on a detector is not very handy as the adjustment of the detector is liable to be effected by the motion caused by moving the switch, and as it is impossible to put it on the phones without having a loose switch, then the best place for the switch to make the above mentioned change in the circuit, is on the condenser. For these reasons if for no other, the adjustable condenser and phone switch make a good combination.



A box about three and one-half inches by five inches by one inch, made of hard wood and finished to match the other instruments is used as the container of the condenser and the top serves as a base for the switches. A binding post is mounted in each corner of the top of the box and two battery switches placed as in the sketch. One of these has two points altho three is desired as it is not a bad idea to have one to short the phones. The number of taps from the condenser is left to the maker.

The first segment of the condenser may be made of two pieces of tin foil separated by oiled paper or linen, the second segment of four pieces of foil and the dielectric, the third of six pieces, etc. The foil and paper of course should be of a size to fit the box. All the segments are connected together at one end and connected to one of the binding posts. The other ends of the segments are insulated from one another and connected to the switch points in order to their size, while the switch arm is connected to a second binding post. The condenser is, before connecting to the switch and binding post, boiled in wax for a time and allowed to cool under as much pressure as can be exerted on it.

The rest of the connections are shown in the sketch, viz.: binding post No. 1 to switch point "b"; No. 2 to "c"; No. 4 to "a"; and the phone switch arm to No. 3. It is well to number the binding posts and keep a hook-up for future reference, as the writer has had to take his instrument apart twice to find the connections as a neglect of it. The connections may seem simple in the sketch, but they are a little more difficult when in doubt.

The connections of the instrument to the rest of the instruments are also shown in the sketch. The binding posts, switch parts, and foil were obtained from the E. I. Co.

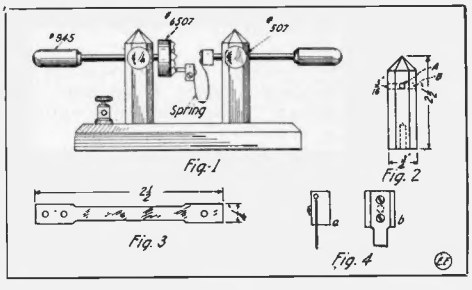
Contributed by FRANK H. BROOME.

THIRD PRIZE, $1.00

A GOOD MINERAL DETECTOR.

A very useful and interesting piece of apparatus for the average amateur to make, is a good mineral detector.

First procure a base of fibre or hardwood (fibre preferred) 3x6 inches. Holes are to be drilled in the base for two uprights, two inches from one end and one and one-half inches from the other, and one and one-half inches from the side. Two holes for the binding posts are drilled as shown. Two pieces of hexagon or square brass rod are used for the uprights, which should be ¾" thick. The tops are beveled off, and they are drilled and tapped as shown in fig. 2. Two knobs (No. 507) with a one inch piece of threaded brass rod (No. 603) are screwed into the knob, which is screwed into hole A. These are used for clamping screws. (hole C is to be used for fastening the uprights to the base, while the hole B is for the rod that holds the cup, as shown at Fig. 1. Two pieces of brass rod 3/16x 2¼" are used and should have the ends threaded with a No. 8-32 die. Two handles (No. 945) are placed on one end of each. One mineral cup one inch in diameter is tapped for one of the rods. A piece of brass ¼x½x½" is drilled and tapped in the center for the other. One piece of German Silver, very thin, ¼ inch wide and 2½ inches long, shaped as shown in Fig. 3, is used for a spring. A piece of brass ¼x¼x1 is drilled as shown in Fig. 4A, with two small holes and then the piece is split with a hacksaw partly thru. On one side a hole is drilled and tapped for a screw, in the second hole a brass wire sharpened to a point is placed. The screw on the side of this piece is to hold the point tight. This piece is connected to the other by the spring as shown in Fig. 1 by two small screws in the piece on the rod. Two binding posts are placed on the base as shown in fig. 1, and connected to the uprights. Galena and other mineral may be placed in the cup with Hugonium Alloy E. I. Co. No. 7778. Most parts may be purchased from the Electro Importing Co. at a nominal cost. By rotating the handles you can quickly find the most sensitive part of the mineral.



Contributed by RALPH HUMPHREY.

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Wrinkles—Receipts—Formulas—Hints

By S. Gernsback.

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. This department will be edited monthly by Mr. S. Gernsback.
We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 1.

Blacking of Metals.

(1) *Dead Black on Brass.*—Take two parts of *Hydrochloric Acid,* and one part of *Nitric Acid.* Mix in a glass bottle and put in as much *platinum foil* as the acid will dissolve, when placed in a warm sand bath. The solution obtained is *Chloride of platinum.* Dip the article, after cleaning, in this solution. This formula is of course expensive as ½ oz. nitric and 1 oz. hydrochloric acid will dissolve about 30 gr. of platinum, but a little of it will do a great deal of work. Very recommendable for optical instruments.

(2) *Dead Black on Brass.*—The following formula is much cheaper and mostly used for inside of tubes, instruments, etc. Take 1 part *Alcoholic Shellac Varnish* and 1 part of *Lampblack.* Mix and thin with enough *alcohol* to make it flow freely with the brush.

(3) *Dead Black on Brass.*—A very permanent and beautiful black used in the French manufacture of arms is obtained as follows: Take a strong solution of *Nitrate of silver* and another solution of *Nitrate of copper.* Mix the two together and plunge the brass in it. Remove and heat the instrument evenly until the required beautiful shade is obtained.

(4) *Blue Black Coating on Brass.*—Dissolve 7 oz. of *copper carbonate* in 1½ qt. of very strong *ammonia.* Dilute the solution with 1 quart of rain water and dip the article in it.

(5) *Dull Black on Copper.*—Take a solution of *Platinum chloride* and dilute same with five times its volume of distilled water (or pure rain water). Brush over the copper article with this solution and when thoroughly dry, rub off with an oiled flannel rag.

(6) *Gun Metal.*—The process for blacking gun barrels is the following: Take 2 oz. of Solution of *Nitric Acid;* 4 oz. of *Tincture of Iron,* 3 oz. of *best grade alcohol,* 3 oz. of *sweet spirits of nitre,* 1 oz. of *Blue Vitriol,* 1½ pt. of *distilled* or *rain water* and mix together. Clean the gun barrel, remove all grease, then coat freely with the mixture, using a piece of sponge. Let dry in a cool place for about 10 hours; remove to a warm place and let stand until quite dry. The barrel must be dry and not sticky or the result will be a red color. Now rub the barrel firmly with lard, then boil for about 10 minutes in water, wipe thoroughly and let cool. Scrape to remove the dead rust, wipe with a clean rag, then begin the whole process over again for six times. The barrel requires *six coats* before it can be finished by oiling

(7) *Black Polish for Iron and Steel.*—Boil together 15 parts of *oil of turpentine,* 1½ parts of *sulphur.* Coat the article very thinly with the mixture and heat over the flame of an alcohol lamp.

(8) *Stove Blacking (Paste).*—A very permanent coating is obtained in mixing 5 parts *black lead,* 5 parts *bone black,* 10 parts *iron sulphate.* Use sufficient quantity of water to form a paste.

(9) *Stove Blacking (Liquid).*—Mix together 2½ parts of *bone black,* 2½ parts of *pulverized graphite,* 5 parts of *copperas,* water in sufficient quantity to form a liquid, creamy substance. Shake bottle before using. This is an excellent polish producing a jet black enamel adherent to the iron.

(10) *Black for Grates, Etc.*—The Berlin stove grate makers use this formula: Melt 5 lbs. *Asphaltum* and add 2 lbs. of *boiled oil,* 1 gal. of *Spirits of Turpentine.* Mix and apply with a brush.

REPRODUCING IMAGES AT DISTANCE BY ELECTRICITY.

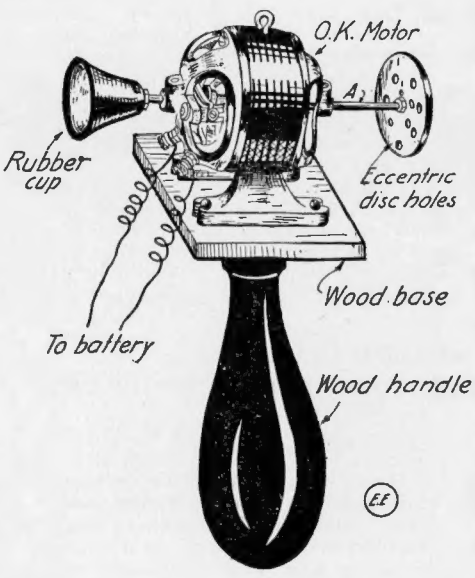
An experimental device has been constructed recently for reproducing images which have been received as electrical impulses. The apparatus, according to the Electrical World, resembles a miniature tile floor in appearance, being about the size of a cabinet photograph and consisting of more than 5,000 minute metal blocks fitted closely together, but insulated from each other. If a thin sheet of liquid is permitted to flow over one face of this panel and current is allowed to flow from the blocks to the liquid their surfaces will become luminous. By permitting electricity to flow through the blocks at different rates, varying intensities of luminosity can be obtained. Each unit composing the panel can be rendered luminous separately or in any sequency desired. Changes in luminosity can be made at the rate of several hundred times per second. By energizing the metal blocks in the proper order and sequences, it is, therefore, possible to reproduce images in motion by transmitting the electrical impulses over wires.

HOW TO HEAR BETTER OVER YOUR TELEPHONE.

When you are trying to hear a long distance party over your telephone have you not often wished for something to help close the ear not in use temporarily? Just the device is at hand, in the "Electro" No. 1024, 40 cent telephone watch-case receiver, which may be readily connected on multiple to any standard telephone receiver; on any line, as shown in the sketch. A 3-foot double conductor cord, No. 4003 is worth but 15 cents. Many thousands of these auxiliary telephone receivers are in use thru-out the country and no matter what *fancy name* you pay for, it is simply a watch-case receiver, the same as here described. Any of our readers can make this attachment in two minutes and can thereby increase the receiving efficiency of their telephone by at least 50 per cent.

A SIMPLE HOME-MADE MASSAGE VIBRATOR.

Many people desire to avail themselves of the great benefits due to thoro electric massaging of the face, etc., but are deterred from doing so owing to the high cost of the necessary vibrator motor and auxilliary apparatus. An efficient massage vibrator is easily made by anyone, from one of the small E. I. Co. battery or 110 volt type motors, mounted on a wood or fibre base and handle, as shown in our illustration. A rubber applicator cup as shown can be purchased for 75 cents of the E. I. Co., and is readily fitted on to the motor shaft, by a couple of jam nuts threaded onto the shaft.



The degree of vibrating massage attained by this machine is governed by a metal disc made of, say ⅛ in. brass, and about 1½ in. diameter. Around this disc is drilled a number of small holes in a spiral or volute path as seen. By placing the shaft thru any desired disc hole, any degree of vibration wanted is readily obtained. The larger the disc and the more eccentric it is placed on the shaft, the greater the vibration produced and vice versa.

The motor is connected with a flexible cord to the battery; which may be 6 dry cells or more, or 110 volts A. C. or D. C. if a suitable "Electro" motor is purchased for the purpose. The disc can be fastened between two nuts threaded on the shaft at A or B, as indicated in the drawing.

STUDENTS BUILD WIRELESS APPARATUS.

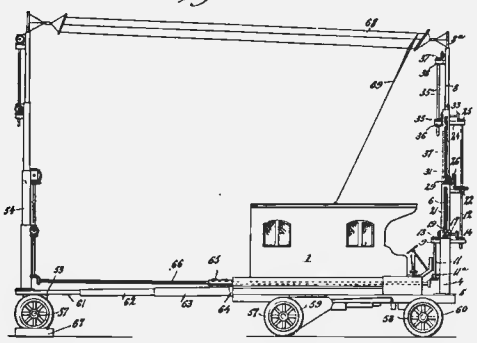
A few industrious students of the various scientific departments at the Central High School of Detroit, Mich., have, under direction of Charles F. Adams, head of the department of physics, constructed a complete and powerful wireless telegraph outfit. The apparatus is now practically perfected and will be operated as soon as a permit can be obtained for transmitting.

LATEST PATENTS

PORTABLE WIRELESS STATION TOWER.

A new design for portable radio station towers with transporting auto truck is described at length in patent No. 1,099,861 issued to Joseph Raes, of Schenectady, N. Y., and it is primarily intended for military operations. The whole apparata may be closed up, so to speak, when not in operation, and the auto truck can then be started up and the whole equipment quickly transported to any place desired at a speed of 30 to 40 miles per hour or more. It should be particularly efficacious for warfare purposes. The auto engine is arranged to raise and lower the mast by gearing or other means as explained in the patent, and the wireless generator is also driven by the auto engine. Suitable engaging levers and clutches are provided for switching the power from the engine to the mast raising and lowering gear; the auto truck propelling mechanism, or the wireless generator. In the words of the inventor:

Fig. 2.



"It will be seen that I have provided a portable wireless station which is adapted especially for use in military operations, or the like, wherein it is desirable to have a number of wireless stations whose position may be changed at any time with as little consequent delay as possible.

"A very desirable feature of the station which I have invented is the fact that it may be operated by a very small number of men, nearly all of the operations being performed by the prime mover of the vehicle itself.

"A portable wireless station comprising a motor vehicle, a tower mounted upon said vehicle and comprising vertically extensible sections, operating mechanism for the said sections, a source of motive power provided upon said vehicle and adapted to be connected operatively with the said operating mechanism, a horizontally extensible support attached to the vehicle, a movable truck connected with the said support, a second tower mounted upon the said truck and including vertically extensible sections, an aerial connecting the uppermost sections of the said towers, operating mechanism for the said tower sections, a transmission shaft including telescopic sections, one of said sections being connected with the operating mechanism of the sections of the last-named tower, and means by which the other shaft section may be connected with the source power, the said transmission shaft being disposed parallel to and coextensive with the horizontal support."

Altho individually considering the separate parts of this device, no radically new inventions are disclosed, yet in its entirety, the whole forms a very compact and efficient design of a portable radio station tower.

NAUEN TOWER COMPLETED.

The gigantic new steel tower of Germany's Central Wireless and Telegraph station at Nauen, near Berlin, from which communication with New York will eventually be established, has just been completed.

It stretches 845 feet up into space, but is so lightly built that only 350 tons of steel were required in constructing it. From the top, which can be reached by both ladders inside the framework and a small wind-driven elevator attached to the exterior, a magnificent view extending over a radius of seventy-five miles is obtainable.

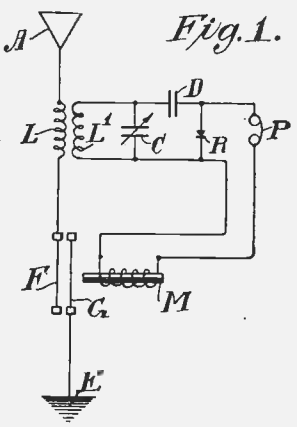
GIVE AVIATORS WIRELESS PRIVILEGE.

W. D. Terrill, United States inspector of radio-telegraphy for the New York district, has advised amateur aviators that they will be permitted to use for emergency calls in flight apparatus sending out a wave of 600 metres length. This privilege is not permitted to land stations, being reserved for government use. The messages allowed are confined to distress or warning signals.

AUTOMATIC TICKER RECEIVER.

John Hays Hammond, Jr., of radio torpedo fame, has produced a novel and extremely simple ticker for the reception of undamped radiotelegraphic waves, having a frequency above audibility; such as used by the Federal Telegraph Co., employing Poulson Arc transmitters, etc. The device is covered under U. S. Patent No. 1,098,380. Fig. 1 A is an antenna, connected in series with an inductance coil L and an electromagnetically-actuated variable condenser F G, and grounded at E. The diaphragm G, forming one of the capacity areas of the condenser F G, is made of iron or other magnetic material. The antenna circuit, by means of the coils L and L1, is coupled inductively with a closed oscillatory circuit comprising the inductance coil L1 and the variable condenser C. This circuit supplies unidirectional current impulses to the telephone P and the electromagnet M, by the action of the stopping condenser D and the rectifier R.

Fig. 1.



The operation of the system is as follows:—A continuous undamped wave is received, with which the antenna circuit A L F G E and the closed oscillatory circuit L1 C are in resonance. The electromagnet M is therefore energized and exerts an attractive force on the magnet diaphragm G of the condenser F G. When G moves away from the other capacity area F of this condenser, the capacity of the condenser is altered, and this change in capacity causes the antenna circuit to be thrown out of resonance with the incoming electric waves, and the antenna circuit receives so little energy, that the electromagnet M is practically de-energized and no longer exerts an attraction on diaphragm G. The latter therefore returns to its original position, the normal capacity of the condenser F G is restored, and the antenna circuit is again restored to resonance with the incoming electric waves. The receiving circuits are therefore actuated and the electromagnet M is again energized. As long as the undamped electric waves continue to arrive, the same cycle of operations is repeated, at a frequency determined by the vibration period of diaphragm G, and there will be produced in the receiving telephone P a sound corresponding to this vibration period of diaphragm G. As the undamped electric waves generally have a frequency above the limits of audibility, the telephone P will not, of course, respond audibly to the action of the electric waves alone and some form of ticker must be utilized, such as the one here described.

LIGHTNING PROTECTION.

At a recent meeting of the Royal Society a paper was read on "Protection from Lightning and the Range of Protection Afforded by Lightning Rods," by Sir Joseph Larmor, F.R.S., and Mr. J. S. B. Larmor. It was pointed out, says "Electrician," London, that on modern ionic views discharge in the atmosphere should originate at a place of maximum intensity of electric field and spread both ways from it along a line which should be roughly the line of force. The explanation of branching, zigzag and multiple lighting discharges was to be sought on these lines. The introduction of a narrow linear conductor could not sensibly disturb a steady field of force, and not at all if it was transverse to the field. Thus it would seem that the top of the building itself, not the lightning conductor, attracted the discharge, and that the function of a single rod could only be to lead it more safely away. But a number of rods distributed over the area of the roof, and effectively connected to earth by a conductor, could by their joint action lift the intensest part of the field from the top of the building to the region around their summits, and so obviate or much mitigate the danger of discharge from above to the building which they covered. In illustration, diagrams were given of a vertical field of force as distributed by vertical pillars of semi-ellipsoidal form and of various breadths, or by an earthed conducting region overhead such as might be originated by gradual discharge from a pointed rod.

Russell Hoffman, of New Lexington, Ohio, writes us:
"I received my first issue of 'The Electrical Experimenter' and think it is the best magazine I ever read."

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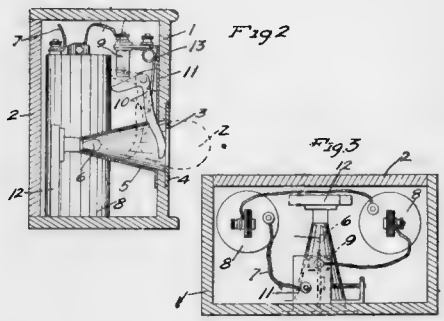
A BATTERY TYPE EGG TESTER.

A simple and low-priced electric egg tester has been patented by a Minnesota man, Melvin P. Baker by name, and this device is readily understood from the accompanying illustration, the U. S. Patent No. being 1,106,127.

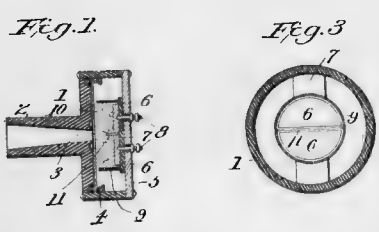
The numeral 1 indicates a rectangular wooden box having a removable back 2, and an annular egg-opening 3 in its front wall. Extending into this opening 3 is a cushioning strip 4 of leather, or other suitable material, against which the egg Z is pressed when inserted into the opening 3. Obviously, this cushioning material will prevent the eggs from being broken when inserted into the opening 3, and it will also yield and closely fit around the egg, so as to exclude all light from the end of the egg projected into the box 1.



Extending from the opening 3 into the box 1 is a horizontal conical casing 5 of thin metal, the large end of which is rigidly secured to the front wall of the box 1. Projecting into the small end of the casing 5 is an electric lamp 6 within an electric circuit 7. Also within the circuit are a pair of dry battery cells 8 and a switch comprising a fixed member 9 and a bell crank 10. This bell crank 10 is pivotally mounted on a bracket 11 of suitable conducting material, and is secured to the front wall of the box 1. The electric lamp 6 is secured to a support 12 extending upward from the box 1. One of the terminals of the circuit 7 is directly connected to the bracket 11, and the other terminal thereof is directly connected to the fixed switch member 9. This switch member 9 is also supported from the bracket 11 but is insulated therefrom. As shown, the fixed switch member 9 is bent from a single piece of spring metal, with its ends in parallel arrangement and normally engaging one another (see Fig. 1). The blade of the switch, or, in other words, the short arm of the bell crank 10, is adapted to be inserted between the ends of the switch member 9, to complete the circuit, as shown by dotted lines in Fig. 2. The long arm of the bell crank 10 extends into the casing 5 into a position to be engaged by the egg Z, and works through a longitudinally extended slot in said casing. A sear spring 13, anchored to the long arm of the bell crank 10 and to the bracket 11, normally holds the short arm of the bell crank 10 in a retracted position, and out of contact with the switch member 9.

The inventor states that the device has proven highly successful in practise and it serves as a good idea to our readers in what a simple but new combination of parts can do toward perfecting a practical patent.

NOVEL TELEPHONIC TRANSMITTER.



A novel form of divided electrode microphone is described in patent No. 1,105,066 issued to John G. Comer. As seen from our illustration this transmitter is arranged with a carbon grain cup or container divided into two halves, so that the current passes in thru one terminal and half cup of grains; over the top of dividing wall in the cup, and out thru the carbon grains in the second half cup to the second terminal. In the words of the inventor:

Figure 1 is a vertical section thru the transmitter; Fig. 3 is a front view of the granular carbon holding cup, the electrodes, the separator, and the diaphragm.

In the drawing, the numeral 1 designates the casing having the tube 2 which parts may be of any approved pattern, the interior of the tube being tapering toward the diaphragm, which latter is designated by the numeral 3 and may be of glass, aluminum, or other suitable material. The diaphragm has the rubber rings 4 bearing thereon near its periphery, on its opposite sides.

To the bridge 5 is secured by screws, or otherwise, the carbon electrodes 6 which are insulated from the bridge by a suitable insulation 7. The electrodes have the terminals 8 secured thereto, and are encircled by a fibrous cotton wall 9 which forms a cup for holding the granular carbon 10.

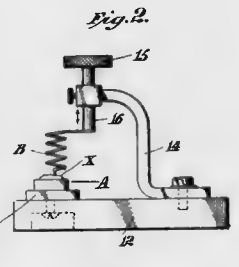
This fibrous wall relieves the diaphragm of the pressure that would result from making the wall of a hard substance, and hence a free vibration of the diaphragm is obtained. The electrodes 6 are separated by a strip of mica 11 which projects into the body of the granular carbon contained in the cup. This separator causes the current to follow a course or circuit extending farther into the body of the carbon granules as it must pass over or around the separator, and thus affords the diaphragm a better opportunity to disturb the path of the current and produce a greater resistance to it. The construction described relieves the diaphragm of weight, deflects the path of the current, and enables the vibration of the diaphragm to better disturb the path of the current and cause greater resistance to it, all of which results in a greater range of vibration, greater sensitiveness, absence of metallic tones, and clearer and more distinct production of the waves of vibration.

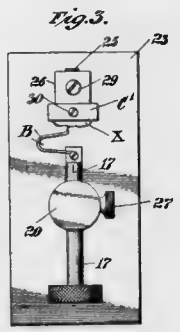
It seems that this form of transmitter affords good opportunities for providing high current carrying capacity, such as required in wireless telephone work.

NEW PICKARD DETECTOR STAND.

The well-known detector specialist, G. W. Pickard, in his patent No. 1,104,073, describes a form of crystal detector stand or mounting which he claims to be particularly efficient. He describes it as follows:

The wire B is of No. 22 manganin, well-known as a hard, springy, non-oxidizable metal alloy which is frequently employed in standard resistance windings on account of its physical constancy. The manganin is of course a very good conductor of electricity relative to the high-resistance rectifier X. The lower end of the wire is shown as offset from the center of the supporting rod, so that the turning of the rod in the jaws of its clamp permits the selection of any desired point of contact of the end of B on X. The loop or loops of B permit a gradual adjustment of contact-pressure, as distinguished from the adjustment possible with a straight wire. Also the contact point of B is held stably against X owing to the springiness or elasticity of B, and this effect is enhanced by the loop or loops of B. The small inertia of B near the contact with X also tends to prevent contact-slipping in case of shocks or jars. Fig. 2 shows a simple form, mounted on an insulating base 12 of hard rubber. The rectifier X (as of silicon) is mounted in readily fusible metal contained in a metal cup A, said cup being adapted to be slid, for metal sur-base 13 which is to be connected to one side of the circuit. The looped wire B, as of manganin or equivalents, is soldered to the end adjustment, over the surface of a of a brass rod 16 provided with an adjusting handle 15 of hard rubber, the rod 16 being adjustable vertically through a bracket 14 screwed to the base 12 and intended to be connected to the other side of the circuit.





In Fig. 3 the wire at B is of platinum-gold alloy or "platinized gold," about one-fiftieth inch or less in diameter, this being by far the best material and form I have employed for this purpose as yet, and having strongly marked properties of general stability, being extremely hard and non-oxidizable, and being also very springy. The gold point or tip on a wire has long been known to be quite superior for crystal rectifiers, such as those using silicon, especially, also the spiral or loop form of the pointed electrode is very much superior to a solid straight wire, especially with galena crystal.

LONDON TO CAIRO BY RADIO.

England and Cairo are to be "connected" by a direct wireless system. Work has been commenced on the English station, which is to be situated at Leafield, in Oxfordshire. There are to be twelve masts 300 feet high. While the immediate objective is to be Cairo, it is expected that its power will give it in the night time a much greater range, probably to Aden.

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AMONG THE AMATEURS

AMATEUR RADIO STATION CONTEST.

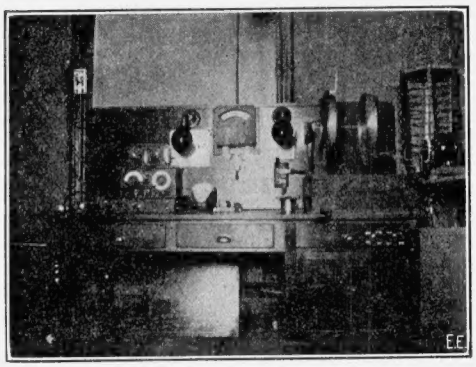
Monthly Prize, $1.00

This month's prize winner.

COLLEGE RADIO CLUB SET.

Enclosed are two views of our club station, built by Memphis amateurs. A high voltage transformer is mounted in the compartment at the right. A glass plate condenser fills the box just below the oscillation transformer. The helix in back of the motor is used as a loading coil for long waves. The motor speed is 3600 R. P. M. and the 18 point disc gives a note similar to that of "N.A.R." A hot-wire ammeter shows in the middle of the picture with a S. P. T. T. switch which connects the aerial either to the ammeter, the oscillation transformer, or the ground.

The sending key and motor starting switch are on the table to the right of the receiving cabinet. New Navy and E. I. Co.'s phones are used with either silicon, perikon or audion detectors.



On the table to the extreme left may be seen a resistance box used in taking shunt readings of received signals. Just to the left of the condenser are a wave-meter and a short-circuiting switch for the break-in system used. With our 110 ft. aerial we have picked up everything from Cape Cod to Colon, Panama, and have transmitted to (5AK) (8IM) and (8XA); and even (9YN) has heard us on exceptionally good nights.

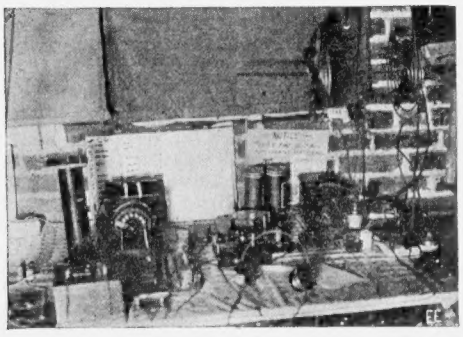
As a matter of justice to *The Electrical Experimenter*, I might say that your monthly is read by every member of the Club, with interest and profit. We wish you every success.

Jno. T. Shea, Secy., College Radio Club,
612 Adams Ave., Memphis, Tenn.

JOHN H. ALDEN'S RADIO STATION.

The enclosed photograph is a picture of my wireless telegraph station.

The aerial is of the "T" type, composed of four strands of No. 14 copper wire 60 feet long, on 8 foot spreaders. It is situated in one of the highest parts of Washington, and is about 60 feet above the ground.



On the right of the photograph may be seen the sending apparatus which consists of a Mesco 1" coil, key, leyden jar, E. I. Co. zinc gap, oscillation transformer, and aerial switch.

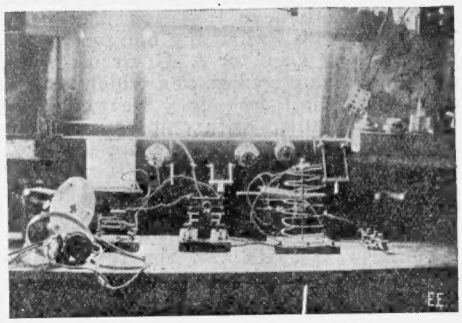
The receiving set consists of a loading coil, single side tuner (used as an auxiliary loader), large loose coupler, potentiometer, variable and fixed condensers, E. I. Co. peroxide of lead detector, galena detector, E. I. Co. "Transatlantic" 2000 ohm phones, and buzzer test.

All apparatus of which I have not mentioned the make, is home-made.

At night I hear many coast radio stations, ranging from Sayville, L. I., to Key West, Fla.

Yours truly, etc.,
John H. Alden, Washington, D. C.

DECKER RADIO STATION.



Having read in the July *Electrical Experimenter*, that you were going to start a wireless station contest, I am inclosing a photo of my station that I would like to enter in the contest.

Here is a description: Sending, one-half inch coil; test tube condenser; helix; spark gap and key. I run the coil on a step-down transformer and it gives a little more than a ½-inch spark.

The helix, spark gap and condenser are home made.

The receiving side is very simple. Using a home-made mineral detector and 2,000 ohm receivers. The aerial switch is also home-made.

When the picture was taken I only had one iron wire for an aerial, 20 feet high and 100 feet long. I am thinking of putting an aerial about 30 or 40 feet high up this fall. I hope to do pretty good work then, for I have added a loose-coupler, loading coil and some fixed condensers to my station lately. I have also finished the rotary spark gap shown.

There is only one other station in this town.

I have been a subscriber to the *Electrical Experimenter* from the first number and think it is fine.

Yours truly,
Glen Decker, Ligonier, Ind.

CONNECTICUT VALLEY RADIO CLUB MEETS.

Dean Lewis and Glenn Savine gave talks on wireless at a meeting of the Connecticut Valley Radio Club in the rooms of the Springfield Yacht and Canoe Club at Springfield, Mass., recently.

MINNEAPOLIS RADIO CLUB NEWS.

The Minneapolis Wireless Club's sending apparatus at the courthouse will be increased in power. It is now capable of sending messages a distance of 500 miles. Messages can be received for 4,000 miles.

Officers of the club were elected at a meeting in the mayor's reception at the courthouse recently.

Hiram P. Maxim has written to Philip Edelman, president of the Minneapolis club that it is certain Minneapolis will be made Western distribution center under the Maxim plan of free transmission of wireless messages.

Father R. A. Dowed, pastor of the Church of Annunciation, Akron, Ohio, is undoubtedly the first minister to install a wireless station for his own private use. His station which is similar to that of the Goodyear Rubber Company, is equipped with a detector so sensitive, that messages may be received clearly from Key West or Georgian Bay.

Albert Thomas, 2909 Federal St., Chicago, Ill., one of the "Electro" fraternity, writes:

"Enclosed you will find three cents in stamps for your 212-page electrical encyclopedia No. 12, and data on your 160-page Wireless Course in 20 lessons, which you give free with purchases made by your customers.

I have purchased many things from your Chicago representative, and find *all of them up to the standard.*"

Le Roy West, a customer of the E. I. Co., living at Hightstown, N. J., has the following to say:

"I would recommend your receivers, especially to amateurs. They are very sensitive. I can hear Arlington, Va., and Sayville, L. I., so loud that I can place my receiver on the table, and hear them fairly plain."

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QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. At least one of the questions must deal with "E. I. Co." apparatus or instruments, or "E. I. Co." merchandise.
2. Only three questions can be submitted to be answered.
3. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
4. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this Department cannot be answered by mail.

"ELECTRO" HIGH FREQUENCY APPARATUS.

(159.) Dr. K., of New York City, desires prices on physicians High Frequency and X-Ray equipment of "Electro" Manufacture, for use on 110 volts A. C. or D. C. universally.

A. 1. We believe that you may be interested in a new "Electro" High Frequency equipment, suitable for operation on a 110 volt D. C. or A. C. circuit, by simply plugging into a common lamp socket, and which apparatus can be used for all forms of high frequency treatment; also for X-Ray work.

This instrument with complete equipment cost $35.00, including set of glass treatment electrodes.

The equipment furnished at the above price comprises, six vacuum electrodes and Universal handle, with connection cord and plug for 110 volt circuit A. C. or D. C. together with connecting treatment cables and cords.

They can furnish also the following auxiliary equipment for this machine at the following prices named:

Fulgeration Electrode	$2.50
Auto Pad. for Elect. Saturation	3.00
Hair Electrode	4.00
Fluoroscope	12.00
X-Ray Tube and Holder	18.00
Besides this they can furnish an Ozone Generator for Ozone Treatment	10.00

This equipment is guaranteed for one year, and it has been on the market for about five years now, and the first one sold is still giving very satisfactory service.

TAPE REGISTERS.

(160.) L. N. Kancus, Flint, Mich., wishes to know:

Q. 1. Can I use an "Electro" tape recorder in a radio receiving set with a crystal detector?

A. 1. Their tape register can only be used with a coherer and not with any form of crystal detector, excepting if you employ an especially made wireless relay, such as described in the March, 1914, "Electrical Experimenter," in detail.

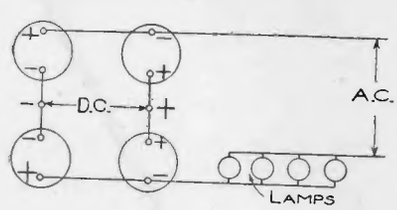
We desire to call your attention to an error however, in this article, in that each magnet on this relay is to be wound with approximately 10½ ounces of No. 36 B & S enameled magnet wire instead of the quantity there stated, which was erroneous.

ELECTROLYTIC RECTIFIERS.

(161.) Ralph K. Carlton, Whitman, Mass., inquires of us:

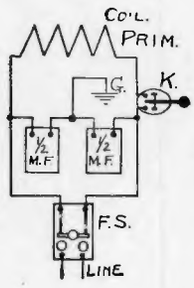
Q. 1. Can I use an E. I. Co., Electrolytic rectifier in conjunction with a step-down low voltage A. C. transformer to charge storage batteries?

A. 1. Answering your query would say that most probably you can get the results you are after by using a one cell electrolytic rectifier in the primary circuit of a step-down A. C. Transformer such as those listed in the new E. I. Co., catalog No. 14, and this sytem is used by several Companies for producing an approximate D. C. wave form current in the secondary low voltage circuit. These rectifiers cannot be used directly on the low voltage A. C. side of the transformer; as at least 40 volts or more, is required to operate these rectifiers, which are of the electro-chemical type.



The usual method of charging storage batteries with the aid of the electrolytic rectifier is covered in detail in the aforementioned catalog, and no transformers are necessary whatever, but simply a bank of 110 volt lamps as shown in the diagram given herewith.

KICKBACK PREVENTERS.



(162.) William Nichols, Ambler, Pa., writes us:

Q. 1. Is a kickback preventer necessary on small spark coils used on 110 volt circuits?

A. 1. Kickback preventers should be used in every case where any induction coil or wireless transformer is used on commercial lighting circuits, to protect the Electric Company's meters and also the circuits in the neighborhood from kickback surges; due to the peculiar operating characteristics of radio transmitting sets. Diagram is given here for the proper connection of an "E. I. Co." kickback preventer.

SELENIUM CELLS.

(163.) Wm. Braun, Atlantic City, N. J., says:

Q. 1. What material does the E. I. Co. handle which is electrically sensitive to light?

A. 1. Selenium is about the only substance with marked variations in resistance due to a variable quantity of light being thrown on same.

They supply also, besides the selenium cells which are worth $5 a piece, antimony cells.

Selenium does not have any constant co-efficient of resistance and its value in this respect, besides several other qualities possessed by it, depends upon the annealing of the cell during its construction, and they always have an assorted lot of them on hand, different cells having different ratios between light and dark resistance, etc.

PRODUCTION OF F-RAYS.

(164.) F. Roesner, Branham, Tex., inquires for data on constructing machines for producing F-Rays, or infra-red rays, such as used by M. Ulivi for blowing up bombs, etc.

A. 1. We have no exact data on hand explaining how to produce the infra-red or F-rays, but, however, same may be described as extremely rapid etheric vibrations, and from the latest reports, it seems that M. Ulivi of Italy, who has an apparatus which he claims to have perfected for the purpose of blowing up bombs, etc., has not produced proper and convincing test of his apparatus.

TAPE RECORDERS FOR RADIO RECEPTORS.

(165.) Fred O. H. St. Thomas, D. W. I., writes:

Q. 1. At what price can I procure of the E. I. Co. a tape register set capable of being operated at high speed for recording commercial radio messages?

A. 1. They can supply a complete receiving set employing an Electrolytic Detector together with special resonance relay and a tape register, etc., which will produce a record of signals received at your station at $35.00 and delivery on same will require 5 to 6 weeks, as they have to be imported from abroad, and it is not made in this country, in so far as we are aware.

MOTOR SPEED CONTROL.

(166.) Louis R. Griner, Millville, N. J., says in a recent letter:

Q. 1. How can I control the speed of a type "S S" motor?

A. 1. The type "S S" dynamo of the shunt wound type should be connected with one of the "Electro" No. 5000 Rheostat regulators in series with the shunt field on same for any speed above normal; and by connecting similar resistance in series with the armature circuit of the machine, any speed below normal, can be obtained.

FIRING A REVOLVER BY RADIO WAVES.

(167.) F. Adams, Portland, Ore., wants to know if he can utilize an "Electro" coherer receiving set to fire a revolver or gun with, etc.?

A. 1. Answering your query relative to the Telimco outfit No. 4, using a coherer, with relay, etc., would say that if you properly arrange a magnet or other device to fire the revolver or rifle as stated, it will work alright of course; and

AmericanRadioHistory.Com

WITH REGULAR BAND

Complete Double Set

2000 Ohms - - $4.00
3000 Ohms - - 5.00

With Coronet Band
$ .50 additional

WITH CORONET BAND

WHAT YOU SAVE

on these remarkably good 'phones will buy other Murdock apparatus for your station. REMEMBER, these low prices do not mean cheapness in the goods. These No. 55 receivers are real wireless 'phones, with pure copper wire coil windings—with resistance guaranteed. They are far superior to any you may obtain elsewhere—in sensitiveness, in materials, in construction. They bring in the signals from far and near with the sensitive precision of more expensive instruments. They work well, look well, and wear well.

MAKE A TEST YOURSELF

We will, upon receipt of price, forward the set desired for fourteen days' trial. If they are unsatisfactory in any way, they may be returned and your money will be refunded immediately.

Prompt shipment is part of the Murdock policy of service to customers. This should be appreciated in holiday-rush times.

Our catalog is free. Ask for it.

WM. J. MURDOCK CO.

55 Carter Street Chelsea, Mass.

680 Howard Street, San Francisco

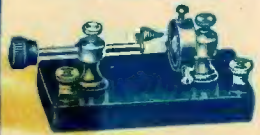
WE ARE HEADQUARTERS FOR ELECTRICAL AND WIRELESS GOODS

Flashlight, 60c.
(2 other styles.)

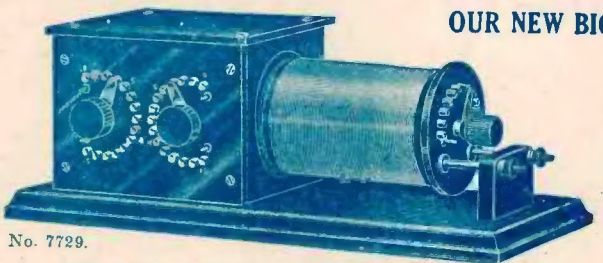
Telegraph Set, $1.00.

Wireless Set, $1.85.
We set the standard in complete receiving and transmitting outfits. Don't buy until you see our Catalog.

Bicycle Light, $1.75.



Crystal Detector, $2.25.
15 other styles from 30c. up



No. 7729.

THE AMCO NAVY TYPE RECEIVING TRANSFORMER

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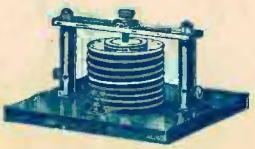

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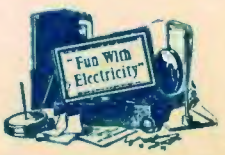

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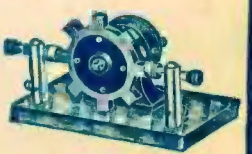

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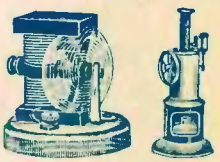

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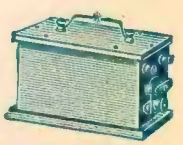

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